YOU OUGHTA KNOW... TECHNICAL PROCEDURES

TABLE OF CONTENTS

HOW TO USE THE TECHNICAL PROCEDURES

The Level I Technical Procedures are your major reference as an Apple Level I Service Specialist. The Technical Procedures are arranged by product, and for each product there are several sections of procedures. Most products have Take-Apart, Diagnostics, and Troubleshooting sections, and some have additional sections on Adjustments and other procedures. Many products also have an Illustrated Parts List section. Each section is numbered, and pages are numbered with the section number first, then the page number, separated by a decimal point. For example, page 1.5 of the Apple II Technical Procedures is the fifth page of Section 1 (Apple II Take-Apart). Each section begins with a table of contents, so that you can find the procedure you need quickly.

Take-Apart

Most Level I repairs consist of replacing faulty assemblies, or "modules," with new or reconditioned ones, because we've found that "module swapping" is the most economical method of repair at Level I, for both the dealer and the end-user. The Take-Apart section for each product contains step-by-step procedures for removing and replacing individual modules of that product. Suppose you have determined that the motherboard on an Apple II is faulty. How do you find the replacement procedure? Behind the **Apple II** tab in the Technical Procedures binder, you'll find the Apple II Table of Contents, and you'll notice that the Take-Apart section is Section 1. Both on this page and on page 1.1, you will find the Table of Contents for the Take-Apart section. "Removing the Motherboard" is on page 1.5.

Adjustments

In the Technical Procedures for some products, there will also be a section called "Adjustments." If a module is having a problem, it may simply need an adjustment. The Adjustments section will tell you what adjustments can be made and how to make them. The Apple Scribe Printer procedures (under the "Scribe Printer" tab) contain an example of an Adjustments section.

Diagnostics and Troubleshooting

For many products, there exists a **diagnostic diskette** or **diagnostic ROM card**, which diagnoses some problems automatically. If a diagnostic tool exists for a product, there will be a Diagnostics section to tell you **how** to use it.

The Troubleshooting section contains tables or flowcharts that will help guide you in isolating problems to a faulty or misadjusted module or part. If there is a diagnostic tool, the Troubleshooting section will tell you **when** to use it.

Using Troubleshooting Charts

Troubleshooting charts usually list the probable causes of problems in order of likelihood. If you are given a list of possible causes and no other instructions, try the first swap or adjustment and test the product again. If the problem is still there, try the next item on the list.

Troubleshooting charts often use abbreviations or short titles when listing the probable causes of problems. If you don't understand what is meant in a chart, use this rule of thumb: if the item on the chart sounds like a replaceable module, look for a procedure in the table of contents, or try to locate the part in the Illustrated Parts List. If it sounds like an adjustment, look in the Adjustments section.

So remember: The Diagnostics and Troubleshooting sections help you find what's wrong with a product. The Take-Apart and Adjustments sections tell you how to fix it. Some products have an Illustrated Parts List that describes the parts, shows their locations, and gives their part numbers.

In general,

1. It is advisable to look over, or even practice, all the technical procedures for any new product before you repair the product for a customer.

2. Whenever a procedure tells you to do something but doesn't give step by step instructions, turn to the appropriate table of contents for help.

NOTE: Sometimes you may wish to see how to do a procedure before you attempt it. If so, refer either to the Service Programs binder or the Technical Procedure to see if a videotape is available for purchase.

You Oughta Know Technical Procedures

Section 1

AppleLink

GENERAL INFORMATION

AppleLink has replaced the Domestic Bulletin Board System and is not available in all International countries. Check with your Apple sales representative on availibility and current information about AppleLink.

If you're currently using AppleLink and need more information, refer to the AppleLink Self-Paced Walkthrough. If you're having trouble using AppleLink, call the AppleLink HelpLine at (408) 973-3309.

THE APPLELINK HTS (HARDWARE TROUBLESHOOTING) FEEDBACK LOOP

What Does the HTS System Consist Of?

HTS articles deal with all hardware repair information in the Tech Info library.

To Use the HTS Identifier:

1. From the Word Search Screen in the Tech Info library enter **HTS** and the **product name** to obtain all of the HTS article titles for that product. If "HTS and the product name" doesn't yield what you're looking for, eliminate HTS and include other logical search words. It could be that what you're searching for might NOT be hardware in nature (though it may appear to be!) and therefore, would not appear under HTS.

2. A Technical Assistance Request (TAR) form (see Figure 1 on the back of this page) appears in all HTS searches. If you are unable to locate information (no database is perfect!), download the form, fill it out, and AppleLink it to your local technical support AppleLink address. Apple's regional technical support persons will respond with an AppleLink E-mail.

How Can I Help HTS to Help Me?

The HTS domain within AppleLink is intended to answer hardware questions on Apple products. That's where we can use your help. When you come across problems that are particularly hard to find or recur a lot, help us help other techs by sending us these problems and their solutions via the TAR form. We'll put them into an HTS document on AppleLink and give you credit with a byline.

THIS FORM IS TO BE USED WHEN REQUESTING TECHNICAL ASSISTANCE.

In order to support you more quickly and efficiently, we request that you submit your queries using this form. The answer will be returned to the same address from which the request was sent. Please SAVE the form to your AppleLink disk so that you will have it available to work with when you are not connected to the network.

When you fill in your form, please do NOT block format as shown below:

System: Apple IIe Enhanced

Problem: After printing a file, user quits from AppleWorks (no save or further actions). Upon....

INSTEAD... please use the following format with all unnecessary spaces removed:

System: Apple IIe Enhanced

Problem: After printing a file, user quits from AppleWorks (no save or further actions). Upon...

We would be very grateful if you would also use this form to share valuable technical information YOU'VE stumbled upon while working with Apple products!

DELETE ABOVE INFO; **SAVE** THE FORM BELOW.

TECHNICAL ASSISTANCE REQUEST FORM (rev. 11/85)

DATE:
REQUESTOR:

SYSTEM (memory, enhanced/unenhanced, # of drives, peripherals, etc.):

SOFTWARE (version number):

DESCRIBE THE PROBLEMS/SYMPTOMS:

ATTEMPTS (what have you tried? the results?):

BEST GUESS (possible cause, possible solution):

REPLY FROM APPLE TECH SUPPORT:

FOR INTERNAL USE ONLY:

FIGURE 1: APPLELINK TECHNICAL ASSISTANCE REQUEST FORM (SAMPLE)

You Oughta Know Technical Procedures

Section 2

Diagnostic Duplication

Contents:

Introduction

The majority of Apple diagnostics are copyable, but there are some that are copy-protected. If an attempt is made to duplicate copy-protected diskettes, there is a good chance that the original will be damaged.

Diagnostic Chart

Below is a chart which lists the diagnostic, tells if it is copyable with Apple software, and gives the program that will perform the copy.

Diagnostic	Backup and Diskette	
Apple II Product Diagnostic, (5.25")	Rev. A	Not copyable
	Rev. B	Copyable - DOS 3.3 (COPYA)
Apple II Peripherals Diskette (5.25")	Copyable - DOS 3.3 (COPYA)	
Apple II SCSI Diagnostic 1.0	Copyable - System Utilities (2.1.1 or higher)	
Apple IIe, IIc Diagnostic 1.0 (5.25")	Copyable - DOS 3.3 (COPYA)	
Apple IIe, IIc, IIGS Diagnostic 1.0 (3.5")	Copyable - System Utilities (2.1.1 or higher)	
Apple IIGS Diagnostic 1.0 (5.25")	Copyable - System Utilities (2.1.1 or higher)	
Apple /// Diagnostic Diskette	Copyable - System Utilities	
Apple /// Plus Dealer Diagnostic Diskette	Copyable - System Utilities	
MacTest 7.0	Copyable - See Section 2 of the **Macintosh Technical Procedures**	

Macintosh Hard Disk Drive Diagnostic	Copyable - Macintosh Finder
ProFile Limited Data Recovery Program 2.0	Copyable - DOS 3.3 (COPYA)
Drive Acceptance Program	Copyable - DOS 3.3 (COPYA)
Digital Diagnostic Diskette (Dysan)	Not copyable
Disk Calibration Diskette (or Disk Alignment Aid)	Not copyable
Disk Alignment Diskette	Not copyable
AppleTalk NetCheck 2.0	Copyable - Macintosh Finder
LisaTest 1.0	Copyable - Option for making backup is on the diskette
Lisa 2 / Macintosh XL Diagnostic 3.0	Not copyable

For more information, turn to the Diagnostic section for the product in the appropriate **Technical Procedures** manual.

You Oughta Know Technical Procedures

Section 3

Keyswitch Replacement

Contents:

NOTE: Keyswitch identification and keyboard exchange information for the Apple II, IIe, ///, and Macintosh is given in Appendix A of the technical procedures for each product.

KEYSWITCH REPLACEMENT PROCEDURES FOR THE APPLE II, IIe, ///, AND MACINTOSH

Tools needed: Soldering iron (60 watt, 700 degrees)
Solder sucker
60/40 resin core solder
#1 Phillips screwdriver

Apple II's have keyboards with three different types of keyswitches: those that screw on, those that snap on, and those that cannot be replaced.

1. Screw-on switches are on keyboards that have both screws and traces on the underneath side of the board of the mechanical assembly.

2. Snap-on switches are on keyboards that have traces but no screws on the underneath side of the board of the mechanical assembly.

3. Keys that are not replaceable are on the newest keyboards which have screws but no traces on the underneath side of the board of the assembly. If any switch fails, you replace the entire mechanical assembly.

CHANGING A KEYSWITCH: SCREW FASTENED SWITCHES

Removing the Keyswitch

1. To determine which key you want to remove, look at Figure 1 and find the number corresponding to the desired key. Locate that number on the back of the keyboard.

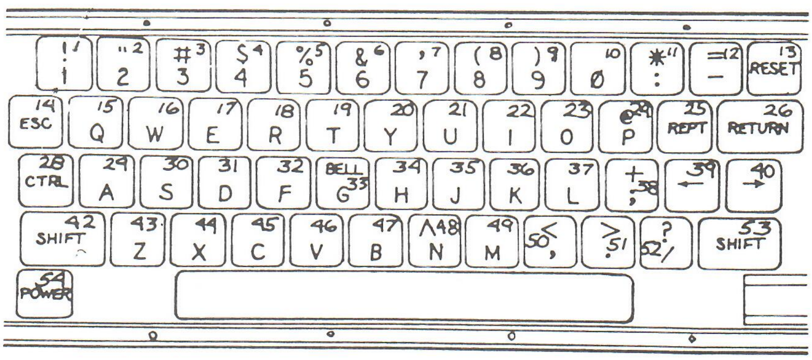


FIGURE 1

2. Prepare the solder sucker by pushing the plunger down as far as it will go.

3. Heat the soldering iron and make sure it is clean and well-tinned.

4. When the soldering iron is ready, put a small drop of fresh solder on each connection. this will facilitate melting and removal of the old solder.

5. Hold the soldering iron and the solder-sucker as shown in Figure 2. The tip of the iron should be firmly in contact with both the pin and the pad at the base of the pin.

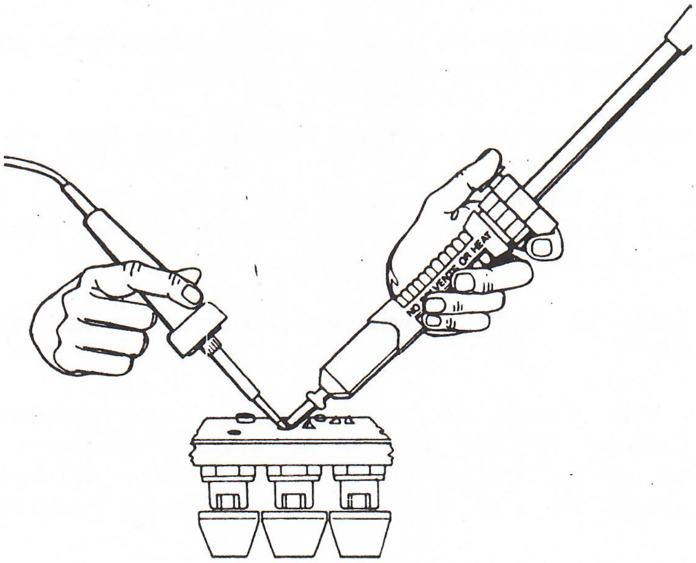


FIGURE 2

6. When the solder melts, quickly remove the iron, place the solder sucker vertically over the connection, and push the release button or lever to pick up the solder.

CAUTION: In the following steps, do not apply the soldering iron for more than three seconds. It may lift the traces off the board and destroy it.

7. Repeat this procedure for the second pin, being careful to observe the 3-second limit.

8. If any solder remains around the base of the pin, apply a little solder to the joint and repeat steps 5 & 6 to make sure all solder is removed.

9. Remove the screw holding the keyswitch to the board.

10. Turn the keyboard right-side up and pull up on the key cap to remove the switch assembly.

Installing the Switch

11. Insert the keyswitch into the board so that pins go through the holes.

12. Holding the key in place with one hand, turn the keyboard upside-down onto the pad.

13. Reinstall the screw that holds the key in place.

14. Apply a little solder to the iron. Then, with the tip in contact with both the pin and the pad that surrounds the pin hole, apply the new solder.

    CAUTION: In the following steps, do not overheat the board!

15. Check the joint to be sure that the solder has completely filled the hole around the pin and that the solder is built up in a little cone around the pin. If the joint is not filled, apply more solder.

CHANGING A KEYSWITCH: SNAP ON KEYS

Removing the Keyswitch

1. Locate the desired key. (See Figure 3.)

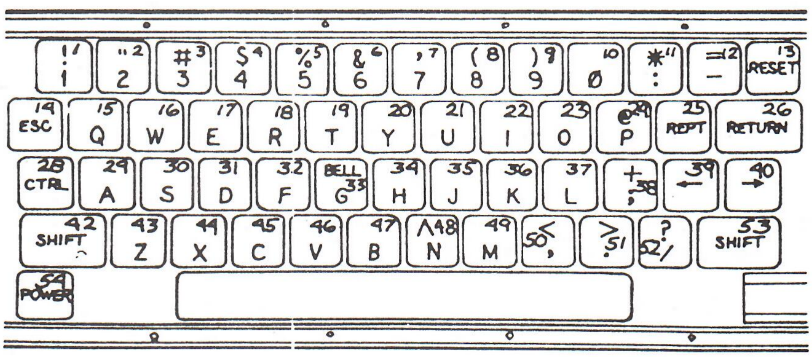


FIGURE 3

2. Put a little resin core solder on the joints.

3. Cock the solder sucker by pushing the plunger down as far as it will go.

4. Hold the soldering iron and the solder sucker as shown in Figure 4. The tip of the iron should be firmly in contact with both the pin and the pad at the base of the pin.

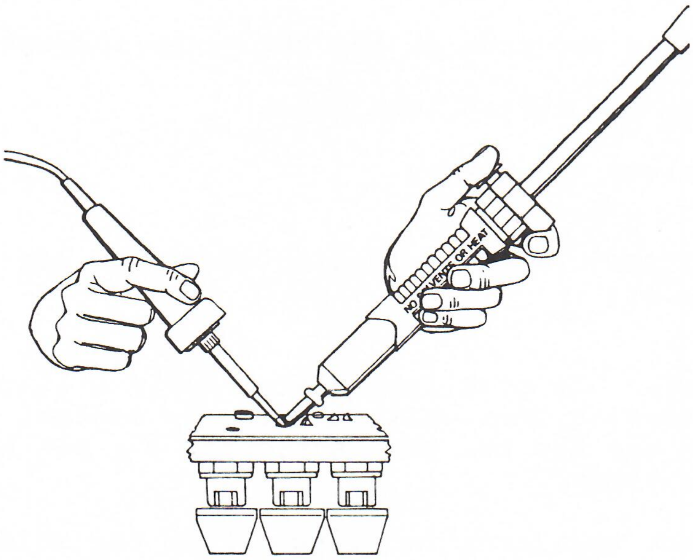


FIGURE 4

CAUTION: In the following steps, do not apply the soldering iron for more than three seconds. It may lift the traces off the board and destroy it.

5. When the solder melts, quickly remove the iron, place the solder sucker vertically over the connection, and push the release button or lever to pick up the solder. Make sure that all the solder is removed.

6. Repeat this procedure for the second pin. Be careful to observe the three second limit.

7. If any solder remains around the base of the pin, apply a little solder to the joint and repeat steps 4-6 to make sure all solder is removed.

8. Turn the keyboard over.

9. Take the key cap off.

10. With one pair of needlenose pliers, pinch the two clips on the keyswitch together.

11. With the other pair of needlenose pliers, remove the keyswitch.

Installing the Switch

12. Thread the pins of the keyswitch through the holes.

13. Snap the switch into place.

14. Replace the keycap.

CAUTION: In the following steps, Do not overheat the board!

15. Solder the pins into place. Apply a little solder to the soldering iron. With the tip in contact with both the pin and the pad that surrounds the pin hole, apply the new solder.

16. Check the joint to be sure that the solder is built up in little cone around the pin. If the joint is not filled, apply more solder.

FIGURE 5

KEYSWITCH REPLACEMENT FOR APPLE IIc

Tools Needed: Medium Phillips screwdriver
Small (jeweler's) flatblade screwdriver
Soldering iron
Solder sucker
Needlenose pliers
X-acto knife
60/40 resin core solder

NOTE: On the keyboards in some early systems, keycaps are bonded to their keyswitch. You will not be able to repair individual keyswitches on those keyboards. Send them back to Apple for repair.

Removing a Keyswitch

Some newer Apple IIc's have ALPS keyboards, which are slightly different from other IIc keyboards. Steps where these differences matter are marked with an asterisk (*).

1. Remove the keyboard from the IIc. (See **Apple IIc Technical Procedures.**)

2. Using Figure 5, locate the number of the keyswitch to be replaced. If the keyswitch solder pads are covered by the stabilizer bar (on the underside), remove the bar by squeezing the plastic prong (between the circuit board and the stabilizer bar at each end) with needlenose pliers.

3. Remove the keycap by gently lifting up with a screwdriver on one of the four sides.

*4. Remove as many of the surrounding keycaps as necessary until the plastic overlay can be peeled back from the edge far enough for the selected keyswitch to be removed without damaging the plastic.

   * There is no plastic overlay on the ALPS keyboard.

*5. Turn the keyboard over and locate the number of the keyswitch to be replaced. There are four connections for the keyswitch, two to the lower left of the number and two to the upper right of the number.

   * There are two connections for each ALPS keyswitch.

6. Apply fresh solder to each of the four keyswitch connections to be desoldered. This transfers heat through the connection faster, making it easier to desolder.

7. Desolder the keyswitch contacts. If any solder is left, use needlenose pliers and gently wiggle the keyswitch pins until the keyswitch can be easily removed.

*8. Peel the plastic overlay back and remove the keyswitch.

  * There is no plastic overlay on the ALPS keyboard.

Installing a Keyswitch

*1. Look at the bottom of the keyswitch and notice the plastic leg on one corner.

  * There is no plastic leg on the ALPS keyboard.

  NOTE: There is only one way for the keyswitch to fit <u>flush</u> against the circuit board.

*2. Peel back the plastic overlay and position the pins and plastic leg of the keyswitch into their holes. Pop the keyswitch into position.

  * There is no plastic overlay on the ALPS keyboard.

3. Turn the board over and check that the plastic leg is in its hole. Otherwise, the key will not fit flat nor work properly.

4. Lay the plastic cover back into position and replace the keycaps.

5. Solder the pins into place.

  CAUTION: While heating both surfaces with the soldering iron, hold the solder against the point where the pin and the pad touch. The heat from the pin and the pad, not the soldering iron, should melt the solder.

6. Check the joint to be sure that the solder is built up in a little shiny cone around the pin. If the joint is not filled, apply more solder.

7. If the stabilizer bar was removed, replace it by inserting the plastic prong in the middle hole on each side of the board.

KEYSWITCH REPLACEMENT FOR APPLE DESKTOP BUS KEYBOARDS (ALPS KEYSWITCHES)

Tools Needed: Medium Phillips screwdriver
Small (jeweler's) flatblade screwdriver
Soldering iron
Solder sucker
Needlenose pliers
Exacto knife
60/40 resin core solder

Removing a Keyswitch

1. Remove the keyboard from the case. (See the technical procedures for the specific keyboard.)

2. Remove the keycap by gently lifting up with a screwdriver on one of the four sides.

3. Turn the keyboard over. Using the keyswitch map (Figure 6), locate the number of the keyswitch to be replaced. There are two connections for each keyswitch.

4. Apply fresh solder to each of the two keyswitch connections to be desoldered. (Adding the fresh solder creates a mixture that transfers heat through the connection faster, making it easier to desolder.)

5. Use the solder sucker to desolder the keyswitch contacts. If any solder is left, use needlenose pliers and gently wiggle the keyswitch pins until the keyswitch can be easily removed.

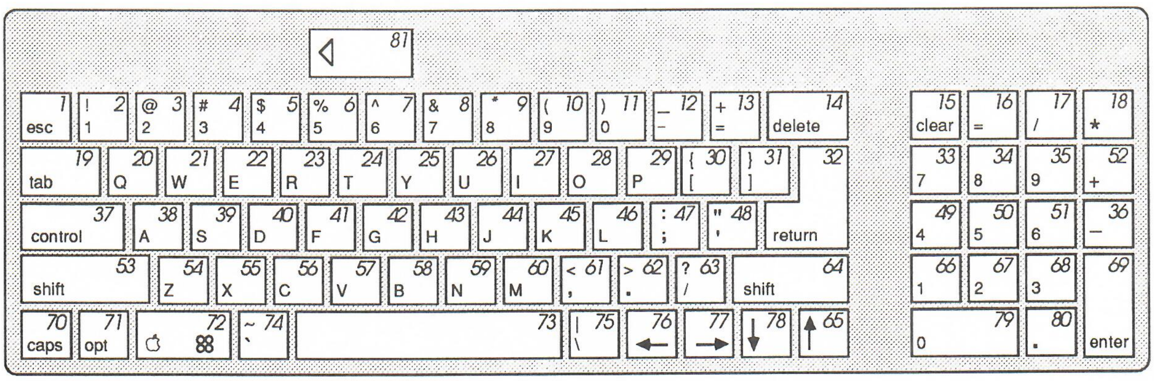


FIGURE 6

Installing a Keyswitch

1. Position the pins of the keyswitch into the appropriate holes on the keyboard and press in.

2. Solder the pins into place.

   CAUTION: While heating both surfaces with the soldering iron, hold the solder against the point where the pin and the pad touch. The heat from the pin and the pad, not the soldering iron, should melt the solder.

3. Check the joint to be sure that the solder is built up in a little shiny cone around the pin. If the joint is not filled, apply more solder.

4. Replace the keycap.

5. Replace the keyboard into the case. (See the technical procedures for the specific keyboard.)

You Oughta Know Technical Procedures

Section 4

Simplified Overview of a Microcomputer System

Contents:

INTRODUCTION

This section presents a simplified overview of how any microcomputer system works. It includes definitions of the basic components of any system (e.g., CPU, ROM, RAM) and descriptions of their functions. It also describes the flow of information through any microcomputer.

More specific information on Apple's various microcomputers and their modules can be found in the troubleshooting sections for the individual products.

WHAT LANGUAGE DOES IT SPEAK?

No matter what operating systems or high-level languages a computer uses, its basic language is binary numbers (0's and 1's). The binary (or "base 2") number system uses only two symbols, 0 and 1. By combining series of 0's and 1's, microcomputers can represent any desired numbers, letters, special characters, and codes.

The two symbols, 0 and 1, are called binary digits or **bits.** The electronic components and circuits used in microcomputers must be capable of assuming two states or values corresponding to 0 and 1. For example, when a switch is on (closed) it can represent a binary 1. When the switch is off (open) it can represent a 0. The 0 and 1 can also be represented by different voltage levels.

In all microcomputers, the basic unit of information (word) contains a fixed number of bits, and the length of a word in a given computer depends on the hardware design of the computer. Microprocessors are available that use 4-, 8-, 12-, 16-, and 32-bit words. The most common binary word length is 8 bits. In microcomputer jargon, an 8-bit word is called a **byte.** A 4-bit word is called a **nibble.** The memory of the microcomputer stores the data or instructions in binary code, 0's and 1's.

COMPONENTS AND FUNCTIONS OF A MICROCOMPUTER SYSTEM

CPU

The CPU or Central Processing Unit combines system control, arithmetic, and logic functions on a single chip. CPUs are sometimes called microprocessing units or MPUs.

The Control Unit of the CPU sequentially looks at and interprets instructions given in a program and issues "orders" to the other components of the microcomputer to carry them out.

The Arithmetic/Logic Unit (ALU) is the part of the CPU where the actual processing of the data takes place. For example, if a "logical and" instruction is stored in memory, and the program calls for it, the control component will get the instruction, interpret it, and send orders to the ALU to perform it.

Buses

Transfers of data in a microcomputer take place in "parallel," which simply means that all bits are moved from the memory to the CPU at the same time. The movement of data takes place along circuits called Buses. Microcomputers have three major buses: a data bus, an address bus, and a control bus.

The Data Bus sends data to and from the CPU, Memory, and Input/Output components.

The Address Bus carries signals that activate the particular areas of the system that the CPU needs to contact. Together with the Control Bus, it drives all of the Memory and Input/Output devices.

The Control Bus carries signals from the CPU that initiate and time the various memory accesses and input/output operations.

Memory

The Memory stores data and instructions which the microcomputer uses. The two types of memory widely used are RAM and ROM.

RAM (Random Access Memory) gets its name from the fact that any location may be accessed at any time. Programs and information are stored here, but only temporarily. The information is erased when the microcomputer is turned off. Once a memory location is enabled (addressed by the CPU), data may be written into or read from that location. The address of the location is usually supplied by the CPU. The data stored in the enabled location comes from or goes to the CPU.

ROM (Read Only Memory) contains permanently stored data and instructions. The data or instructions stored in ROM can only be retrieved, not changed; data cannot be written to ROM. When the power is turned off, the information in ROM remains intact. Frequently used instructions are usually stored in ROM rather than on a disk. This allows faster and more convenient access to commonly used instructions. For example, when you turn a system on, the CPU accesses the ROM for instructions on how to start up.

Input/Output

Input/Output operations connect the microcomputer to external ("peripheral") devices. The most common I/O operations allow the microcomputer to communicate with a human operator through input devices such as the keyboard and mouse and output devices like the monitor and printer. Disk drives, modems, and similar devices are used for both input and output.

I/O operations take place through a special component of the microcomputer, usually referred to as an interface. This component may also be referred to as an I/O port. The interface is connected to the CPU via the three buses (data, address and control).

Input/Output (continued)

There are two widely used forms of input/output: parallel and serial.

In parallel data transmissions, all bits of the binary word are sent to the output device simultaneously. This means there must be one path (circuit) for each bit of data which is being sent (see Figure 1 below).

SIGNAL CONNECTIONS

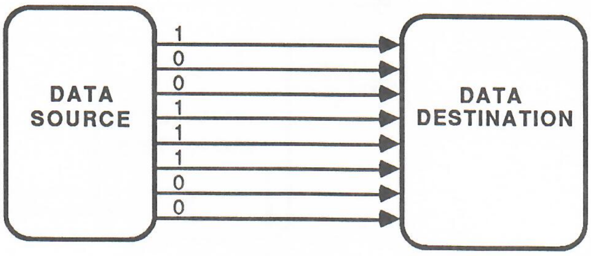


FIGURE 1

In serial data transmission, the binary data is sent one bit at a time. Serial data transmission is the most widely used method of communication between microcomputers and peripherals. In Serial communications, each bit is transmitted for a fixed time interval. This bit time is referred to as baud rate (or bits per second). Baud rates vary widely in microcomputer and data-communication systems. Popular rates are 300, 1200 and 9600 (see Figure 2 below).

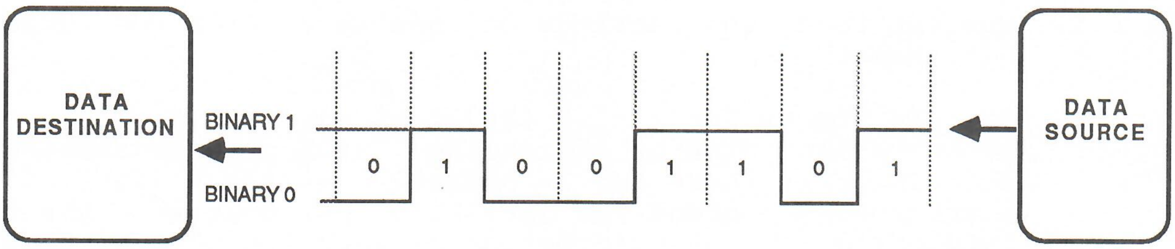


FIGURE 2

FLOW OF INFORMATION IN A MICROCOMPUTER SYSTEM

The diagram below (Figure 3), with its numbered arrows, shows how information flows through a microcomputer system. The numbered steps beneath the diagram correspond to the numbered arrows.

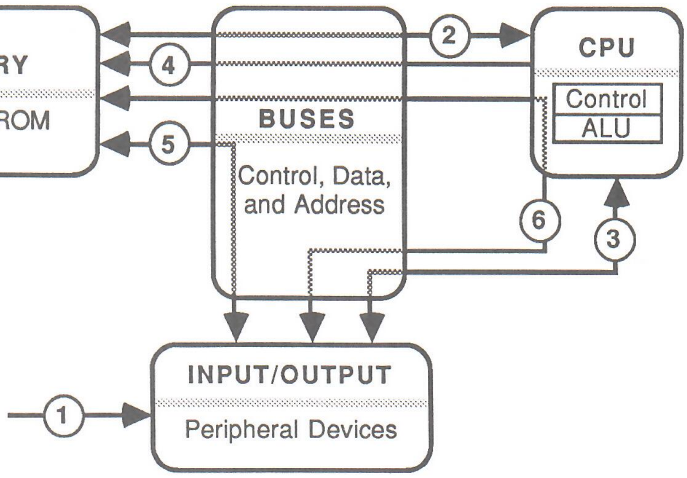


FIGURE 3

1. A diskette is inserted into a disk drive (I/O device) and the microcomputer is turned on.

2. The CPU reads instructions on what to do from ROM (Read Only Memory).

3. The CPU checks for a disk (I/O device). The disk can be either a hard disk or a diskette. If a disk is present, the CPU looks there for an operating system. The microprocessor needs the operating system to know how to handle the flow of information between the hard disk or diskette and RAM (Random Access Memory).

4. After locating the operating system, the CPU puts a copy of it into a specified location in RAM.

5. A copy of whatever program (application or language) is on hard disk or diskette is put into RAM. RAM now contains the operating system and the program.

6. At this point, the user may enter data from the keyboard (I/O device). The data is processed in the CPU and sent to RAM for temporary storage. Information stored in RAM should be periodically saved to hard disk or diskette. The instruction or command to save is sent from the keyboard to the CPU. The CPU sends the appropriate instructions to RAM. The RAM then sends the information to the CPU, where it is routed to the hard disk or diskette for permanent storage.

   When your data is safely saved on hard disk or diskette for future use, the microcomputer may be turned off.

Summary

The CPU is the nerve center of the system. It performs all the central control functions. All arithmetical, logical, and operational decisions are made here. The CPU gets instructions from memory, decodes them, and issues the instructions to the appropriate components.

The Memory component stores instructions and data. The instructions are stored in sequence in binary code, so that the microcomputer knows what to do. While it is performing an operation, the CPU needs data to use or to manipulate. This data is usually brought in through an I/O device. After the operation on the data is completed in the CPU, the new data is sent to memory to be stored.

The Input/Output component, as its name implies, passes information back and forth between external devices and the microcomputer.

The buses carry the data (which is in binary code) between the components. The three buses are Data, Control, and Address.

GLOSSARY: SOME COMMON TERMS

Applesoft editor - A routine (short program) stored in ROM in the Apple II family of computers. The Editor allows you to type and correct programs in the Applesoft BASIC language.

Applesoft interpreter - A routine stored in ROM in the Apple II family of computers. The Interpreter translates the instructions in an Applesoft BASIC program into machine language, so that the computer can perform them.

clock or (oscillator) - The basic source of synchronizing signals in a microcomputer. The clock produces an alternating signal with a stable frequency. The clock's **pulses** (or cycles) are used to synchronize all events in the computer.

clock pulse - One cycle of the alternating signal produced by the clock.

keyboard and keyboard encoder - When a key is pressed, the keyboard sends seven bits of information to the keyboard encoder. The keyboard encoder transforms this information into a signal that the computer can interpret.

Monitor - A program stored in ROM which acts as a supervisor for the computer. The Monitor program controls all programs, and all programs use it.

peripheral - A device which is attached to the computer, but is not part of the computer. Most peripherals are input/output devices. Examples: printer, disk drive, keyboard, video monitor, etc.

power supply - The power supply converts the AC line voltage into a DC voltage.

timing - The interval between the rise and fall of any signal in the microcomputer.

You Oughta Know Technical Procedures

Section 5

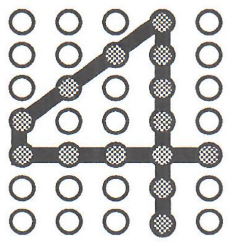
Dot Matrix Technology

Contents:

INTRODUCTION

The most commonly used low-cost printing technology is dot matrix printing. The following section will tell you how dot matrix technology forms characters.

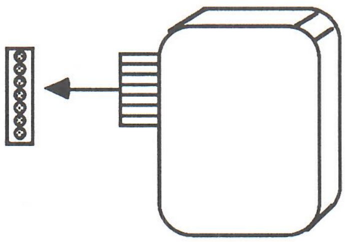
WHAT IS MATRIX PRINTING?



The dot matrix method of printing is both fast and effective. It gives the printer the capability of producing many different font styles, and graphics as well. The letters, however, are not fully formed; instead, they are made up of single dots that are combined to resemble letters, numbers, and various special characters.

The dots are arranged so that any character may be formed. The matrix pictured to the left is 5X7. Higher density dot patterns (7X7 and 9X12 matrices) permit more fully formed characters and higher-resolution graphics.

HOW DOES IT PRINT?



Dot matrix characters are printed by a special print head which is made up of a group of wires vertically positioned. A 5X7 matrix printer has seven closely spaced wires in the print head, as shown at the left. The end of each wire can independently strike the paper through the ribbon.

As the print head moves horizontally across the paper, one space increment at a time, characters are generated by properly controlling which print wires strike the paper. In a 5X7 matrix printer, each character consists of five columns, with anywhere from zero to seven dots in each column.

The Dot Matrix Printer, the ImageWriter and the ImageWriter II all use this method of printing. Refer to **ImageWriter** or **ImageWriter II Troubleshooting** for a diagram and description of the flow of information through each printer.

You Oughta Know...

Section 6 – Electrostatic Discharge (ESD)

❑ CONTENTS

❑ INTRODUCTION

Static (or "stationary") electricity is, simply, electricity that is not moving. And it is harmless as long as it remains static. Unfortunately, an electrical charge is unstable and is always looking for an opposite charge to unite with. When a charge moves, it becomes a *current*—often a greater current than a microcircuit can handle.

You may already know that touching a chip lightly with your fingertip can degrade a circuit so that it never again performs to specifications. But did you know that brushing certain kinds of clothes (like your polyester shirt) over a printed circuit board can do the same thing? In fact, unprotected electronic devices can be "zapped" just by waving a charged object nearby.

The smallest charge you can feel is 3,000 volts; the smallest charge you can see is 5,000 volts; and the smallest charge you can hear is 10,000 volts. **But some of the newest semiconductor devices are susceptible to as little as 10 volts, or one three-hundredths as much as you can feel.**

Electrostatic discharge (ESD) has therefore become more and more of a hazard as microcircuits have become smaller and more sensitive.

This section contains rules for preventing ESD damage to equipment you are working on. It also contains instructions on setting up an ESD-safe workstation. **These rules and instructions hold true whether you are working at your shop or at a customer's site.**

❑ ESD PREVENTION RULES

Here are the rules you need to learn and follow to prevent ESD damage. We have included a key word above each rule as a memory aid:

Grounds

Before working on any device containing a printed circuit, ground yourself and your equipment to an earth or building ground.

Use a grounded conductive workbench mat and a grounding wriststrap, and ground your equipment to the mat.

WARNING: *Make sure you are* ***not*** *grounded when :*

- *You work on plugged-in equipment*
- *You discharge a Cathode Ray Tube (CRT)*
- *You work on an unplugged CRT that has not yet been discharged*

Bodies

Don't touch anybody who is working on integrated circuits.

If that person is properly grounded, your "zap" may not cause any damage, but just to be on the safe side, do not touch or brush against other technicians.

Bags

Use static-shielding bags for boards and chips during storage, transportation, and handling.

When you are ready to leave your bench and take a board to a storage place, first put the board in a static-shielding bag. Leave all Apple service exchange components in their ESD-safe packaging until you need them.

Leads

Handle all ICs by the body, not the leads.

Also, do not touch edge connectors on boards or cards, exposed circuitry, or printed circuits. Handle ICs, boards, and cards by the edges, or use extractors.

Synthetics

Do not wear polyester clothing or bring plastic, vinyl, or styrofoam into the work environment.

The electrostatic field around these nonconductors cannot be removed.

Metals

Never place components on any metal surface.

Use antistatic, conductive, or foam rubber mats.

Atmosphere

If possible, keep the humidity in the service area between 70% and 90%, and use an ion generator.

Charge levels are reduced (but not eliminated) in high-humidity environments and in areas where an ion generator is used routinely.

❑ SETTING UP AN ESD-SAFE WORKSTATION

Materials Required

Conductive workbench mat, with ground cord
Wriststrap, with 1 megohm resistor and ground cord
Equipment ground cord, with alligator clips
Ground/polarity tester

Setup and Procedure

After you gather the materials above, **remove all ESD hazards from the area**:

- Styrofoam
- Common plastics
- Synthetic clothing
- Vinyl

These nonconductive materials cannot be grounded and will retain a charge for hours and even days. Since the static field surrounding them can easily damage sensitive components, it's best to keep these materials completely out of your work area.

After you remove the ESD hazards, proceed as follows:

1. **Use a ground/polarity tester to verify proper grounding of the power outlet.**

   Ground/polarity testers vary slightly in design, but all are very simple to use. Insert the three prongs

of the tester into the three-prong outlet. If the outlet is wired incorrectly, most testers show a light pattern that matches a code given on the tester.

If the tester does not verify proper grounding, move to another outlet that is safe—whether you are at the customer's site or at your shop.

2. **Connect the ground cord of the workbench mat to ground.**

3. **Use a wriststrap ground cord. Fasten it to the workbench mat and to the wriststrap.** The wriststrap should touch your skin.

   All objects in the service area should be grounded to the same potential. Touching the chassis of a machine will bring you to the same potential as the machine, which is better than nothing. However, since just the act of shifting your weight from one foot to the other can generate static, momentary "touch" grounding is not enough. That is why you need the continuous grounding provided by a grounded wriststrap.

4. **Finally, ground the equipment you are working on.**

   Use alligator clips and a grounding cord to attach any metal part of the device you are working on to the grounded workbench mat.

   If you are working on a product that has a three-prong power cord, you can attach the ground pin of the power cord to the workbench mat using your alligator clips and ground cord. (Of course, the unit will not be plugged into the wall outlet.)

WARNING: *When you discharge a CRT or work with a powered-on CRT, do <u>not</u> wear a wriststrap, and do <u>not</u> work on a grounded pad.*
